An Examination of Dental Abnormalities in Rural and Urban Bobcats (*Lynx rufus*)

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Summary

26 bobcats skulls (*Lynx rufus*) roughly half from rural counties and half from urban counties were examined macroscopically for evidence of dental anomalies including tooth loss, fractures, and periodontitis. The most common findings were tooth loss fractures, and periodontitis affecting 88%, 96%, and 70% of all the specimens, respectively.

Introduction

The bobcat (*Lynx rufus*) is a member of the family Felidae, which includes other mammals such as lions (*Panthera leo*), cheetahs (*Acinonyx jubatus*), and domesticated cats (*Felis silvestris catus*). Members of this family are highly specialized hunters that have the ability to kill prey of equal and sometimes greater size than themselves (Etnyre et al. 2011). Adaptions such as a digitigrade posture resulting in rapid strides, strong forelimbs, and large eyes with excellent vision allow members of the family Felidae to be highly successful hunters (Etnyre et al. 2011). Within the family Felidae, the bobcat is of medium size. They range in mass from 4 to 15 kg and in length from 65 to 105 cm, not including the length of the tail (Ciszek 2002). Bobcats display sexual dimorphism with males being about 10% longer and 25-80% heavier than females (Lariviere and Walton 1997). The name bobcat comes from the shortened tail, which measures only 11 to 19 cm in comparison to the longer tails of other species in the family (Ciszek 2002). In comparison, the tail of a tiger may range from 60 to 91 cm in length (Sartore 2017). The bobcat is listed as of least concern on the IUCN Red List of Threatened Species (Kelly et al. 2016). This means that bobcats are found in a large area and their populations are stable rather than declining at a

rapid rate. Currently, the bobcat is found across most of North America and is represented by 12 subspecies (Figure 1a).

In the wild, bobcats can live up to 12 years (Ciszek 2002). The main threats to the success of bobcats in the wild are loss of habitat causing genetic isolation, hunting related to the increasing price of their fur, and secondary exposure to rodenticides (Kelly et al. 2016). Bobcats are solitary animals and typically only interact with other bobcats during the mating season (Ciszek 2002). They tend to be territorial, marking a territory of up to 7 km^2 with urine, feces, and anal gland secretions (Ciszek 2002). The size of their home range can vary depending on abundance of food and the mating season. As the abundance of food decreases, bobcats increase their home range to gather more food (Lariviere and Walton 1997). During the mating season in early spring, the home range of males is at its largest, but the home range for females is smallest during the mating season (Lariviere and Walton 1997). They are able to live in a wide variety of habitats as indicated by their large geographic distribution. Research shows that bobcats tend to favor areas with little human development, but they are also adapting to urbanization of their habitats. They have even been found raising litters in human structures on occasion (Kelly et al. 2016).

Bobcats are strict carnivores, feeding on animals such as rabbits, rodents, and even young ungulates (Kelly et al. 2016). While hunting, bobcats take advantage of all available cover before pouncing and striking (Lariviere and Walton 1997). The adult bobcat has a total of 28 teeth (Figure 2), with a dental formula of I 3/3, C 1/1, P2/2, M 1/1 = 28 (Aghashani et al. 2016). Powerful jaws and secodont detention assist bobcats in cutting and gnawing meat; specifically, the maxillary fourth premolar and mandibular first molar are used to shear off meat (Aghashani et al. 2016). Additionally, the anterior cusp of the third premolar is used for crushing bone (NHC 2018). Because the bobcats' teeth are vital to catching prey and shearing muscle tissue, their dentition is vital to survival. As carnivores adapt to increasing urbanization, they may also experience shifts in food habits (Larson et al. 2015). Increased interaction with humans in more urbanized environments might put bobcats at greater risk for injury as well. Because both changes in diet and possible risk of injury might result in changes in dental morphology, I hypothesized that Oklahoma bobcats from more urbanized counties would show increased levels of dental abnormalities

compared to bobcats from more rural counties. To investigate differences in dental structure I examined skulls from rural and urban bobcats for several dental characteristics.

Methods

All the skulls used in the study were housed at the Oklahoma State University Collection of Vertebrates (COV). Skulls were obtained by the COV through prior research activities, carcass recovery, and donations from the Oklahoma Department of Wildlife Conservation between 1949 and 1980. I used 26 bobcat skulls in total. Of those 26 skulls, 12 were recovered from 3 counties in Oklahoma that were listed in the top 5 Oklahoma counties based on population size (U.S. Census Bureau, 2010). These urban counties were Oklahoma, Canadian, and Comanche counties (Figure 1b). Fourteen of the skulls were recovered from counties listed within the bottom 5 counties based on population size (U.S. Census Bureau, 2010). These rural counties were Cimarron, Ellis, and Roger Mills counties (Figure 1b). Overall, the skulls were identified in COV records as 10 females, 8 males, and 8 with unidentified sex (Figure 3). Skulls from urban counties included 5 females, 6 males, and 1 unidentified. For rural counties there were 5 females, 2 males, and 7 with unidentified sex used in the study. Due to the uneven distribution of the sexes between the most and least populated counties, sexes were not analyzed separately statistically.

Skulls were also categorized as adult or juvenile. This was determined based on the presence or absence of deciduous teeth and overall stage of development of the teeth. The study included 6 juveniles and 20 adults. Samples from urban counties consisted of 3 juveniles and 9 adults. Samples from rural counties included 3 juveniles and 11 adults (Figure 4). Uneven distribution of ages among the skulls were listed but not used to run statistical analysis for this category.

I photographed each skull for later reference and analysis. Photographs were taken of the front and lateral view of the upper and lower jaw articulated in their natural position as well as an individual picture of the upper and lower jaw. After data on sex and age were recorded, each skull was examined for dental conditions listed in Table 1, modified from the previous study of Aghashani et al. 2016. The presence or absence of all teeth were recorded and categorized as congenital, acquired, or artefactual when absent. The missing

teeth were also recorded by type of tooth (canine, incisor, premolar, or molar) and if they were from the upper or lower jaw. This information was used to compare the relative difference between the rural and urban counties, including comparisons between overall tooth loss between urban and rural counties, tooth loss by type of tooth, tooth loss on the upper jaw, tooth loss on the lower jaw, and tooth loss categorized by type of tooth loss (artefactually absent, presumably acquired, and presumably congenital). A macroscopic examination of each tooth was performed to determine if any abnormalities of the tooth's form were present. A large majority of the teeth were glued in their alveoli as part of the preparation process. This precluded examination of the teeth's roots to determine if they possessed normal or abnormal number of roots.

Next, the specimens were examined for supernumerary teeth or persistent deciduous teeth. If found, these teeth were recorded and categorized by type of tooth and presence on the upper or lower jaw. Attrition and abrasion were searched for in each specimen, and the presence of attrition and/or abrasion were recorded but the severity level was not categorized. Any teeth showing the presence of enamel hypoplasia were also recorded.

Each skull was also examined for several types of tooth fractures (enamel fracture, uncomplicated crown fracture, and complicated crown fracture). Fracture types were based on a classification system used on human teeth according to the World Health Organization (Aghashani et al. 2016). The number and type of fractures for each specimen were recorded and noted by type of tooth and location on the upper or lower jaw. These numbers were used to compare between the urban and rural counties. Comparisons included overall fractures, fractures for each tooth type, fractures on teeth from the upper jaw, fractures on teeth from the lower jaw, and total number of fractures from each classification of fracture type as listed above. Presence or absence of periodontitis was also recorded. The classification of severity of periodontitis was based on a well-established system for skull specimens and outlined in Table 1 (Aghashani et al. 2016). Periodontitis was categorized as stage 1 – 4 with stage 1 (periapical lesions) listed as the least severe form and stage 4 being most severe. Periodontitis was then recorded by type of tooth and location on either the upper or lower jaw. These values were used to compare the

prevalence of periodontitis between rural and urban counties and the severity of periodontitis between the two county types.

Additional observations were recorded if the information was relevant and unique. This included information such as potential gun shot wounds affecting the teeth, malocclusions, and staining of the teeth. Any unique occurrences were photographed individually for a better view of the abnormalities that may not have been apparent in the original photographs.

Results

Twenty-six total specimens were used in this study. Forty-six percent of the specimens were from urban counties and 54% of specimens came from rural counties. Thirty-eight percent of the specimens were female, 31% were male, and 31% were of an unidentified sex. Twenty-three percent of the specimens were classified as juveniles and 77% of the specimens were adults.

Teeth Absence

Of the 728 teeth possible, assuming each specimen has a normal set of 28 teeth, 122 teeth were missing. Thirty-five percent of missing teeth were from specimens from the urban counties and 65% of missing teeth were from rural counties. Only 3 individuals, 2 from rural counties and 1 from an urban county, exhibited no tooth loss of any kind. A large majority of missing teeth was classified as artefactually absent with 70% of the total missing teeth from both rural and urban counties classified as artefactually absent. Distribution of the total number of teeth missing among the three categories is found in Table 2.

The percentage of individuals that exhibited artefactual tooth loss separated by type of tooth located on the upper and lower jaw is found in Table 3. The most common teeth found to be artefactually absent in bobcats from the rural counties were the upper canines (50%) and incisors (50%). For the urban counties the upper canines and incisors and the lower canines and incisors were found to be absent most frequently (42% for each tooth type). Upper premolars were the teeth least likely to be absent in both rural and urban county individuals (7% and 0%, respectively). Overall, more teeth in the upper jaw were

found to be artefactually absent than teeth in the lower jaw for both sets of counties. Out of the 86 teeth listed as artefactually absent, 27% of those were found in animals from urban counties and 73% of the artefactually absent teeth were from rural county specimens.

Presumably acquired tooth loss was the second most prevalent form of missing teeth with 32 teeth classified in this category. Fifty-nine percent of missing teeth classified as presumably acquired absent were from urban counties and 41% were from rural counties. There was no distinct trend among presumably acquired teeth lost on the upper and lower jaw. Since so few individuals exhibited presumably acquired tooth loss, it was not possible to determine which type of tooth was most likely to exhibited this type of tooth loss. The percentages of individuals that exhibited presumably acquired tooth loss separated by type of tooth and location on the upper and lower jaw can be found Table 4.

Lastly, presumably congenital tooth loss was the least prevalent form of absent teeth. Only 6 teeth were found to be congenitally absent, split evenly between rural and urban counties. Additionally these absent teeth were from 4 animals with 2 animals coming from each set of counties. All 6 of the congenitally absent teeth were lower incisors.

Malformation of Teeth

Malformed teeth were recorded in 13 specimens, 6 from urban counties and 7 from rural counties. The majority of malformations were bigemination of incisors (Figure 5). This occurred in 4 individuals from rural counties and 4 individuals from urban counties. Additional malformations included malformation of the crown and additional cusps on premolars or molars (Figure 6).

Supernumerary Teeth and Persistent Deciduous Teeth

No supernumerary teeth were found in any of the specimens. Persistent deciduous teeth were found in 2 specimens, both from urban counties. One individual retained all 4 deciduous canines in addition to the mature canines (Figure 7), and the other specimen retained a deciduous upper premolar. One juvenile specimen from a rural county showed mature teeth located in the jaw and unerupted (Figure 8).

Enamel hypoplasia

Enamel hypoplasia was found in 4 specimens, 2 from rural counties and 2 from urban counties. All cases were found on teeth in the lower jaw, usually only on one tooth, either the molar or premolar (Figure 9).

Attrition/Abrasion

Attrition or abrasion was found in 58% of urban specimens and 64% of rural specimens. A total of 62 teeth presented signs of attrition or abrasion, 40% from teeth of urban specimens and 60% from teeth of rural specimens. Therefore, 11% of all the teeth present showed signs of attrition/abrasion. Table 5 presents the percentages of individuals that exhibited signs of attrition or abrasion separated by type of tooth. In both urban and rural county specimens there was no pattern concerning the amount of attrition/abrasion on the upper and lower jaws. Upper and lower canines and premolars were the most likely to have attrition/abrasion and upper and lower incisors were the least likely to have attrition/ abrasion.

Fractures

Three categories of fractures were recognized: enamel fracture, uncomplicated crown fracture, and complicated crown fracture. There were 214 total fractures resulting in 38% of all teeth present having some type of fracture. Fifty-six percent of all of the fractures were from rural specimens and 44% of the fractures were from urban counties. Overall, enamel fractures account for 70% of all the fractures for all the specimens. The distribution among rural and urban counties of the different fracture types is shown in Table 6. The majority of the fractures were classified as enamel fractures with a total 69 enamel fractures from urban counties and 79 enamel fractures from rural counties, or 47% of all urban fractures and 53% of all rural fractures. The upper and lower incisors were the least likely to exhibit enamel fractures. Upper and lower premolars were most likely to have enamel fractures. The percentages of enamel fractures separated by tooth are given in Table 7. In both rural and urban counties, enamel fractures were more common on the lower jaw with 59% and 61% respectively of enamel fractures occurring on the lower jaw.

Uncomplicated crown fractures were the second most prevalent type of fracture. There were 44 total uncomplicated crown fractures, with 34% coming from urban counties

and 66% coming from rural counties. For uncomplicated crown fractures there was no trend for the number of fractures located on the upper or lower jaw. Table 8 presents the percentages of individuals that had uncomplicated crown fractures. The upper and lower canines were the most likely to have uncomplicated crown fractures. None of the upper and lower incisors and upper molars exhibited uncomplicated crown fractures.

Complicated crown fractures were the least prevalent type of fracture with only 22 instances, half of which occurred in rural counties and half in urban counties. Neither the upper nor lower jaw was more likely to have a complicated crown fracture. The upper molars and lower incisors from both urban and rural counties did not exhibit any complicated crown fractures. The small subset of complicated crown fractures meant I was unable to determine which type of tooth was most likely to have a complicated crown fracture.

Periodontitis

Periodontitis was categorized as stages 1 through 4 (Table 9). Stage 1, periapical lesions was the least common for both sets of counties and stage 3 was the most common for both sets of counties. Sixty-nine percent of all skulls examined exhibited some stage of periodontitis. Fifty-seven percent of rural bobcats and 83% of urban bobcats had some form of periodontitis.

Additional Observations

Three specimens, 2 from urban counties and 1 from rural counties, had potential gunshot wounds based on areas of shattered skull. Two specimens from rural counties had unusual staining on their teeth. One specimen from a rural county had 4 lower incisors rotated nearly 90 degrees in the mouth.

Discussion

The Collection of Vertebrates housed at Oklahoma State University has a large collection of bobcat skulls, much larger than the sample size used for this study. The relatively small sample size was based on the number of individuals available for the top 5 and bottom 5

populated counties allowing for a relatively even number of individuals from each population category. The specimens were collected over a large range of years and from all over the state of Oklahoma. Due to the range of collection sites other factors such as the type of habitat may have influenced results in addition to the rural and urban settings that were examined in this study. In addition the collection and preparation methods for each specimen was unknown and could have varied, which could have resulted in other potential differences not related to the factors being studied here. Some skulls showed damage from preparation methods and previous handling, but this did not affect the ability to examine the relevant tooth anatomy.

The majority of missing teeth were considered to be artefactually absent with only 31% of missing teeth considered to have been lost during the animal's lifetime. These data are fairly consistent with Aghashani et al., (2016), in which only 20.4% of missing teeth were lost during the life of the animal. The most common type of tooth lost by acquired means was a lower incisor, which was consistent with Aghashani et al. (2016). Congenital tooth loss was rare, accounting for only 5% of tooth loss. Other studies on tooth anomalies in bobcats (Agashani et al. 2016) and feral cats (Verstraete et al. 1996) found that the most common tooth lost by congenital means were upper and lower incisors and the upper molar. I found that the only instance of congenital tooth loss in this study occurred for lower incisors. This was found equally in rural and urban bobcats.

Tooth malformations were found in 54% of the specimens making it more common than studies with larger sample sizes (Aghashani et al. 2016). The most common malformation observed was bigemination of incisors, typically the lower incisors. Other malformations found included additional cusps on molars and large crowns on premolars. Malformations were distributed nearly evenly among rural and urban populations. No supernumerary teeth were found in this study, but a study done on feral cats found that 10% of their population had at least one supernumerary tooth (Verstraete et al. 1996). Persistent deciduous teeth were rare in this population, resulting in only 0.9% of all the teeth present. Larger studies found that persistent deciduous teeth were still rare, only occurring in 2% of the sample population. All persistent deciduous teeth found in this study were from urban specimens. Enamel hypoplasia was found in 4 individuals, or 15% of specimens, split evenly from urban and rural populations. There is a wide range in

occurrence of enamel hypoplasia reported in the literature; two previous studies found 0% occurrence and 24.6% occurrence (Agashani et al. 2016, Verstraeta et al. 1996).

Attrition/abrasion was a common observance in this study. Although the two processes that result in wear of teeth are different, the two were grouped together because it was not possible to distinguish between the two since both result in similar appearance of the teeth. Attrition/abrasion affected 65% of all the specimens in this study, including 67% of urban populations and 64% of rural populations. This only affected 11% of all the teeth present. The most common teeth that had signs of attrition/abrasion were the upper and lower canines and the premolars. Other studies found that attrition/abrasion was slightly more common affecting 85.2% of the specimens, 24.1% of the teeth, and most commonly affected the incisor, molar and canine (Aghashani et al. 2016).

Tooth fractures were the most common observation in the study affecting 96% of the specimens and 38% of all the teeth present. Only one individual from the urban counties had zero fractures of any type. The enamel fracture was the most common type of fracture affecting 27% of the teeth present in the study. Complicated fractures were the least common type of fracture affecting only 1% of the teeth in the study. Another study on bobcats found that factures affected 50.9% of the specimens and 7.7% of the teeth (Aghashani et al. 2016). A study on feral cats found that fractures affected 54.8% of the population and 7% of the teeth (Verstraete et al. 1996). However for feral cats, the most common type of fracture was complicated crown fractures and root fractures unlike the majority of enamel fractures in bobcats (Verstraete et al. 1996). All fractures types had higher recordings in rural populations.

Periodontitis is the third most common finding in this studying affecting 70% of the specimens. The diagnosis of periodontitis was difficult due to the lack of soft tissue and may have led to errors in classification in periodontitis. Aghashani et al. (2016) found that 56% of specimens were affected by periodontitis. In a study on feral cats periodontitis was found to affect 48% of the studied populations. 57% of the rural specimens were affected by some stage of periodontitis while 83% of urban populations were affected. The most common stage of periodontitis recorded was stage 3 and periapical lesions (stage 1) were the least recorded stage of periodontitis.

The most common abnormalities in this population of bobcats were tooth loss, tooth fractures, and periodontitis closely followed by attrition/abrasion. Tooth loss and tooth fractures of any type were more common in the rural populations with 60% and 56% of the respective abnormalities. Of 8 individuals that did not show any sign of periodontitis, 6 were from rural populations, leaving only 2 individuals from urban counties that showed no signs of periodontitis. Other findings such as enamel hypoplasia, attrition/abrasion, and persistent deciduous teeth were recorded but occurred much more rarely. Some findings were so severe that it would likely affect the animal's ability to eat and survive. Rural bobcats had a higher number of missing teeth, fractures, and attrition/abrasion. No difference was found in the prevalence of malformation of teeth. Urban bobcats were the only ones that exhibited persistent deciduous teeth. Periodontitis was more common in urban bobcats. However, with small samples sizes it is difficult to generalize the information to larger sample sizes of urban and rural bobcat populations.

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Tables and Figures

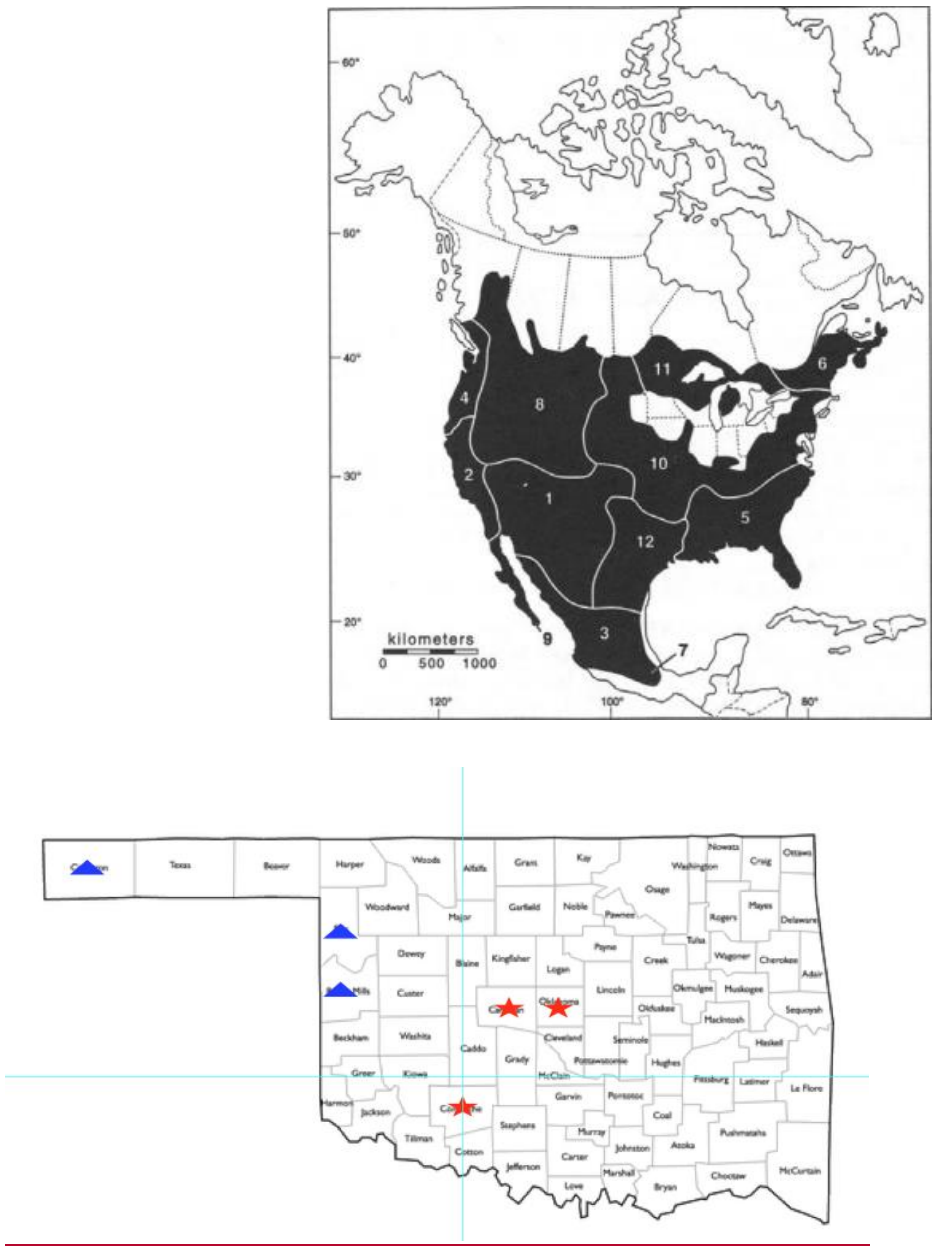

Figure 1. a. Geographic range of the bobcat (*Lynx rufus*) in North America divided by subspecies. 1, *L. r. baileyi*; 2, *L. r. californicus*; 3, *L. r. escuinapae*; 4, *L. r. fasciatus*; 5, *L. r. floridanus*; 6, *L. r. gigas*; 7, *L. r. oaxacensis*; 8, *L. r. pallescens*; 9, *L. r. peninsularis*; 10, *L. r. rufus*; 11, *L. r. superiorensis*; 12, *L. r. texensis*. (Source: Lariviere and Walton 1997), b. Counties from which bobcat specimens were collected, red stars indicate counties classified as urban, blue triangles indicate counties classified as rural.

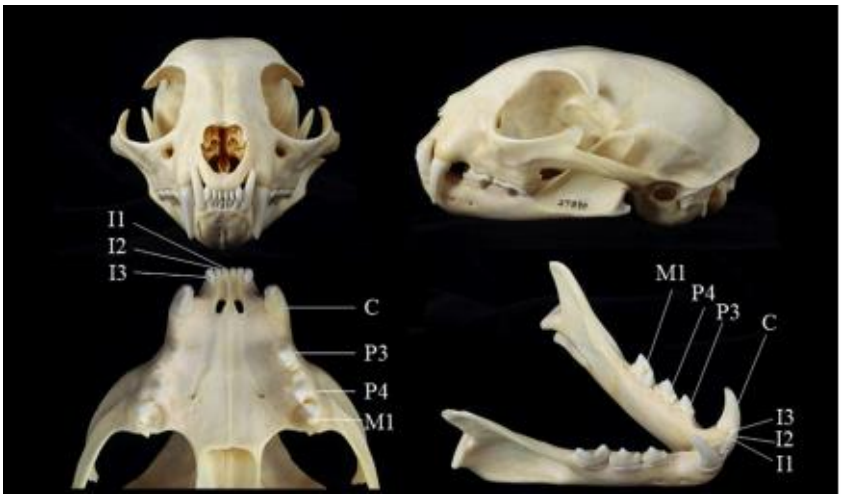

Figure 2. Normal detention of an adult bobcat (*Lynx rufus*). (Source: Aghashani et al. 2016)

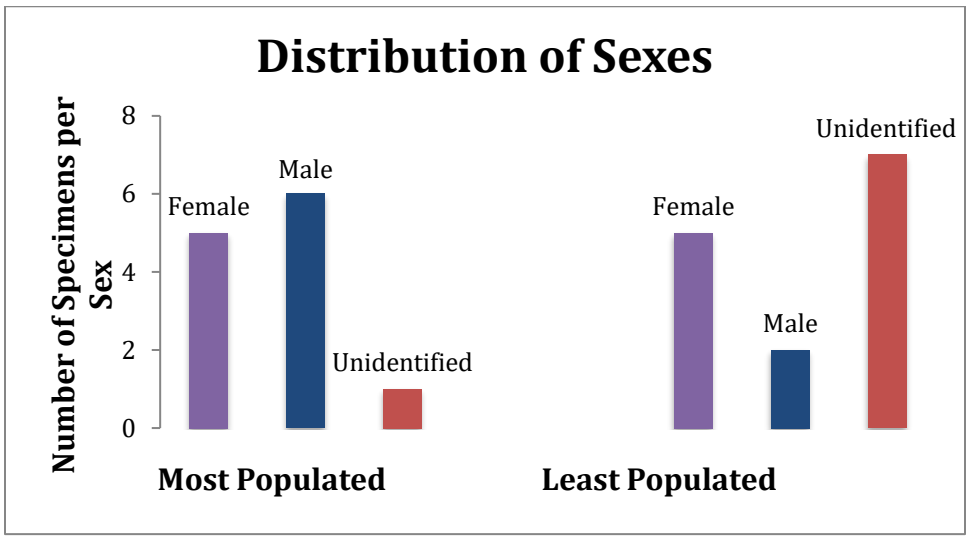

Figure 3. Distribution of males, females, and specimens of unidentified sex bobcats (*Lynx rufus*) found within the most and least populated counties.

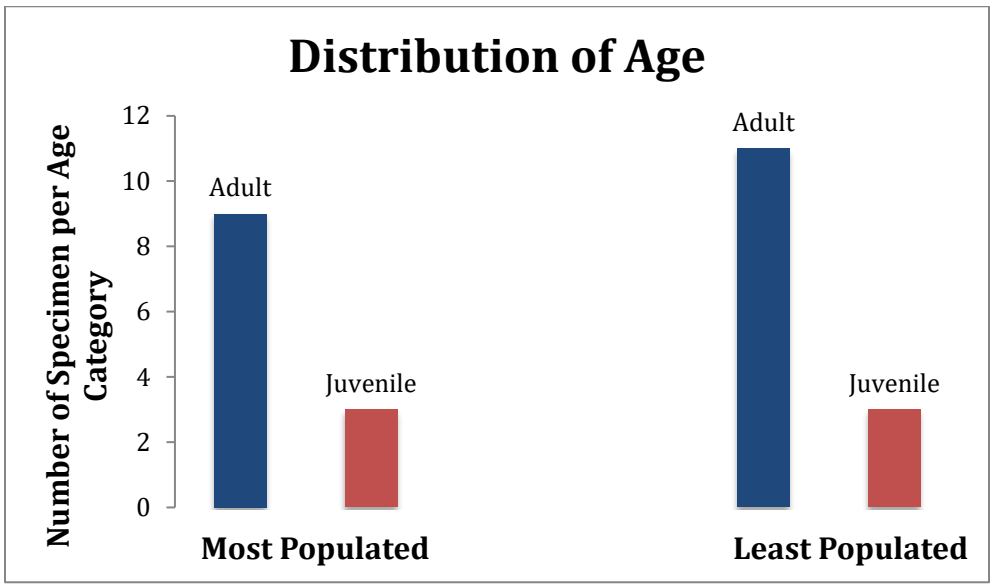

Figure 4. Proportion of samples of bobcats (*Lynx rufus*) identified as adults and juveniles within the most populated counties and the least populated counties. The majority of specimens in the study were recorded as adults.

Figure 5. An example of bigemination of a lower incisor in an adult male bobcat (*Lynx rufus*) from Roger Mills County.

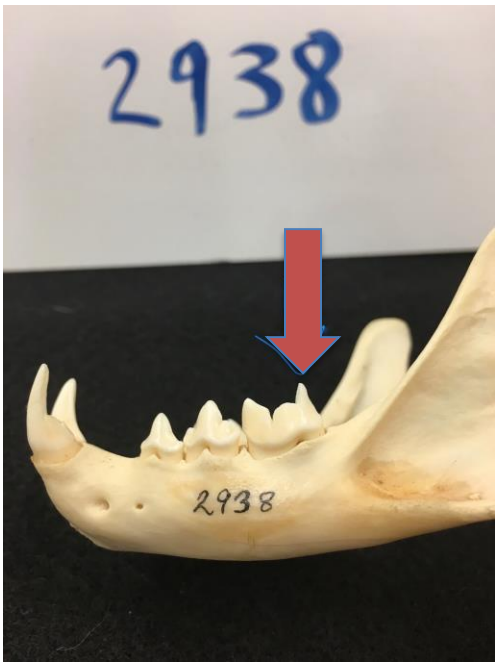

Figure 6. An example of an additional cusp on the lower left molar of an adult female bobcat (*Lynx rufus*) from Cimarron County.

Figure 7. Persistent deciduous lower canines adjacent to mature canines in a juvenile male bobcat (*Lynx rufus*) from Oklahoma County.

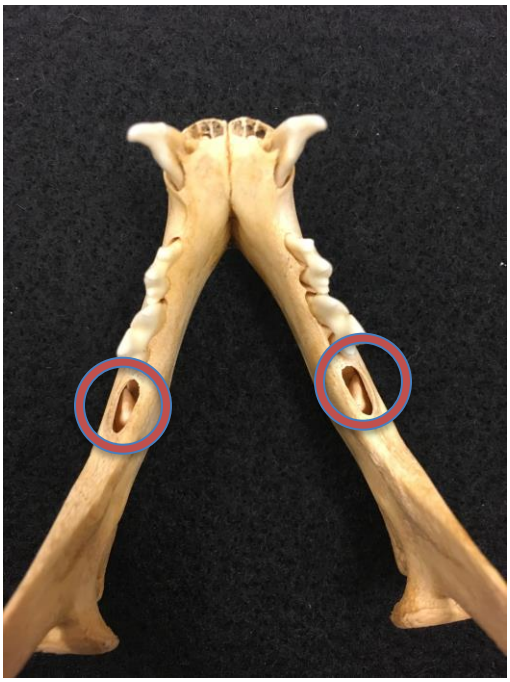

Figure 8. Presence of unerupted mature teeth still located in the lower jaw in a juvenile male bobcat (*Lynx rufus*) from Cimarron County.

Figure 9. Enamel hypoplasia found on the lower right first premolar identified by the discoloration of the tooth in an adult female bobcat (*Lynx rufus*) from Canadian County.

Table 1. Criteria used to classify and record dental abnormalities in bobcats (*Lynx rufus*) from Oklahoma. Modified from Aghashani et al. (2016).

Observation	Criteria
Tooth artefactually absent	Jaw fragment missing or tooth absent, but a well defined, sharp-edged, normally shaped, empty alveolus present; no pathological signs in the alveolar bone; tooth presumed lost during preparation or post-mortem manipulation of the skull.
Tooth absent (presumably acquired)	Tooth absent; alveolus or remnant alveolus visible; alveolar bone shows pathological signs (i.e. rounding of the alveolar margin, shallow alveolus, periosteal reaction on alveolar bone, increased vascular foramina).
Tooth absent (presumably congenital)	Tooth and alveolus absent; smooth, morphologically normal bone present at the site; no physical space for that tooth to have occupied.
Malformed tooth	Presence of an abnormally shaped crown, as in two fused teeth.
Supernumerary tooth	Presence of a supernumerary tooth adjacent to an expected tooth (or alveolus).
Persistent deciduous tooth	A persistent deciduous tooth adjacent to an erupted or unerupted permanent tooth.
Attrition/ abrasion	Rounding or flattening of the cusp tip; exposure of dentine, with or without tertiary dentine formation.
Enamel fracture	A chip or fracture in the enamel only.
Uncomplicated crown fracture	A fracture involving enamel and dentine, but not exposing the pulp.
Complicated crown fracture	A fracture involving enamel, dentine, and cementum, with pulp exposure.

Periapical lesions—stage 1	Macroscopically visible periapical bone loss, root tip resorption, sinus tract formation originating periapically or obvious focal periosteal reaction overlying the apex.
Periodontitis—stage 2	Evidence of increased vascularity at the alveolar margin (more prominent vascular foramina in, and slightly rougher texture of, the bone of the alveolar margin).
Periodontitis—stage 3	Rounding of the alveolar margin; moderate horizontal or vertical bone loss.
Periodontitis—stage 4	Widening of the periodontal space; severe horizontal or vertical bone loss; tooth mobile in the alveolus.
Enamel hypoplasia	Irregular pitting or a band-shaped absence or thinning of the enamel, consistent with the clinical signs of enamel hypoplasia.

Table 2. Distribution of missing teeth among bobcats (*Lynx rufus*) from rural and urban counties in Oklahoma across 3 categories of missing teeth.

Category of Missing Teeth	Rural Counties	Urban Counties
Total teeth missing	79	43
Teeth artefactually absent	63	23
Teeth absent (presumably acquired)	13	19
Teeth absent (presumably congenital)	3	3

Table 3. Percentage of bobcats (*Lynx rufus*) from rural and urban counties in Oklahoma that exhibited artefactual tooth loss based on type of tooth.

Type of tooth	Rural Counties	Urban Counties
Upper canine	50%	42%
Upper incisor	50%	42%
Upper premolar	7%	0%
Upper molar	29%	17%
Lower canine	7%	42%
Lower incisor	29%	42%
Lower premolar	14%	17%
Lower molar	21%	8%

Table 4. Percentage of bobcats (*Lynx rufus*) from rural and urban counties in Oklahoma that exhibited presumably acquired tooth loss based on type of tooth.

Type of tooth	Rural Counties	Urban Counties
Upper canine	7%	0%
Upper incisor	7%	8%
Upper premolar	7%	0%
Upper molar	14%	17%
Lower canine	0%	0%
Lower incisor	7%	25%
Lower premolar	0%	0%
Lower molar	7%	0%

Table 5. Percentage of bobcats (*Lynx rufus*) from rural and urban counties in Oklahoma that exhibited attrition/abrasion based on type of tooth.

Type of tooth	Rural Counties	Urban Counties
Upper canine	36%	33%
Upper incisor	0%	0%
Upper premolar	36%	25%
Upper molar	0%	17%
Lower canine	21%	25%
Lower incisor	0%	0%
Lower premolar	36%	17%
Lower molar	14%	17%

Table 6. Distribution of fractures among bobcats (*Lynx rufus*) from rural and urban counties in Oklahoma across 3 categories of fracture types.

Category of Facture	Rural Counties	Urban Counties
Total fractures	119	95
Enamel fractures	79	69
Uncomplicated crown fractures	29	15
Complicated crown fractures	11	11

Table 7. Percentage of bobcats (*Lynx rufus*) from rural and urban counties in Oklahoma that had enamel fractures based on tooth type.

Type of Tooth	Rural Counties	Urban Counties
Upper canine	29%	33%
Upper incisor	0%	8%
Upper premolar	71%	83%
Upper molar	14%	0%
Lower canine	43%	25%
Lower incisor	7%	0%
Lower premolar	64%	67%
Lower molar	29%	67%

Table 8. Percentage of bobcats (*Lynx rufus*) from rural and urban counties in Oklahoma that had uncomplicated crown fractures based on tooth type.

Type of Tooth	Rural Counties	Urban Counties
Upper canine	71%	25%
Upper incisor	0%	0%
Upper premolar	21%	17%
Upper molar	0%	0%
Lower canine	36%	33%
Lower incisor	0%	0%
Lower premolar	7%	8%
Lower molar	21%	8%

Table 9. Percentage of bobcats (*Lynx rufus*) from rural and urban counties in Oklahoma that had signs of periodontitis

Stage of Periodontitis	Rural Counties	Urban Counties
Stage 1	7%	0%
Stage 2	14%	33%
Stage 3	29%	67%
Stage 4	29%	25%